International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 8, Issue 3, Jun 2018, 785-790

TESTING THE WEAR CHARACTERISTICS OF NATURAL FIBER COMPOSITE

R. VIJAYAN[1], A. KRISHNAMOORTHY[2], M. ARAVINDHAN[3], R. MANIKANDASARAN[4], V. SANJAY[5] & S. YUVARAJ[6]

[1]*Assistant Professor & Research Scholar, Department of Mechanical Engineering, Sathyabama Institute of Science and Technology, Veltech, Chennai, Tamil Nadu, India*

[2]*Professor, Department of Mechanical Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India*

[3,4,5,6]*Department of Mechanical Engineering, Vel Tech Engineering College, Chennai, Tamil Nadu, India*

ABSTRACT

Car world has an expanded enthusiasm for the diminishment of weight by the substitution of steel by fiber fortified composites. Common strands are rising as ease, lightweight and clearly naturally better options than glass filaments in composites. Fabrication is carried by hand lay-up technique. The present work carries the analytical and numerical analysis of mono leaf springs. The testing was performed with the help of Universal Testing Machine (UTM) and the analysis is done by using ANSYS workbench.

KEYWORDS: ANSYS, Universal Testing Machine (UTM) & Fabrication

Received:Mar 13, 2018; **Accepted**: Apr 03, 2018; **Published**: Jun 01, 2018; **Paper Id**.: IJMPERDJUN201882

Original Article

INTRODUCTION

In recent years, the demand for a clean environment has lead to the innovation for green materials and usage of natural materials. Composites are among those versatile, high-performance materials which combine the unique mechanical and thermal properties that cannot be achieved in single materials. The characteristic strands have been considered as another option to the manufactured filaments for fortification in polymeric composites in light of the financial and natural focal points. A composite material is a blend of at least two that outcomes in preferable properties over those of the individual parts utilized alone. Two materials in which one of the materials, called the reinforcing phase, is in the form of fibers, sheets, or plastics, and is embedded in the other materials called the matrix phase Kumar et al [1] determined the friction and wear performance of glass fiber using a pin on disc machine. The test was conducted using and setting for four control variables – normal load, sliding speed, sliding distance, and fiber loading. The results showed that a proper combination of the factors considerably affected the wear and friction behavior of the composites Koji Kato [2] recognized that the wear and coefficient of friction are two primary factors in which it controls the tribological properties of coatings, composites, metallic alloys, and ceramics. Mimaroglu et al [3] said that low density and tailoring capability of polymer composite and fiber reinforced polymer composite offer the attractive mechanical and tribological characteristics compared to the traditional metallic materials. Rahul Premachandran et al [4] had studied the pin-on-disk machine for testing three properties: wear properties, frictional properties and contact resistance. The study further revealed that load, track

diameter, time and temperature were used as parameters to control the test environment. The technical potential of pin-on-disc tribomachine can be achieved by working under optimal parameters SapuanandMaleque[5] fabricated banana fiber the woven fabric epoxy composite household telephone stand. Sastra et al [6] analyzed the influence of reinforcing fiber in long random, short random and woven roving form on the tensile properties of epoxy composites. They found that woven roving form reinforcement resulted in higher tensile properties. Sapuan et al [7] compared all the mechanical properties of woven banana/epoxy composite by Analysis of Variance statistical analysis tool and concluded that composite had stable average mechanical properties. Jawaid et al [8] carried out the tensile properties of palm/jute fiber reinforced polymer hybrid composites.

TRIBOMETER

A tribometer is an instrument which is used to measure tribological characteristics such as coefficient of friction, friction force and wear rate between two mating surfaces. A pin on disctribometer comprises of a stationary stick under a connected load in contact with a pivoting plate. A pin-on-disc test rig (ASTM: G99, DUCOM - India) was used to study the wear properties of the specimen. The experiment was conducted for the calculated speed, time and sliding distance in a High chromium high carbon steel disc with 22 mm track diameter. The 8 mm diameter specimen was held within the specimen holder perpendicular to the steel disc. Three trials were conducted for each specimen individually in the pin-on-disc test rig and the average values were used. Before conducting the test, the disc was cleaned with acetone. The experimental test set up can be witnessed. The stick can have any shape to reenact a particular contact yet circular tips are utilized most. The coefficient of rubbing is ascertained by the proportion of frictional power to stacking power of stick.

Figure 1

EXPERIMENTAL DETAILS

Technique

The hand layup system is one of the most established and most ordinarily utilized techniques for the produce of the composite parts. The infrastructural prerequisite for this technique is less. The preparing steps are very basic. To start with fluid paraffin is showered on the shape surface to maintain a strategic distance from the adhering of fiber to the form surface. Thin plastic sheets are utilized at the best and base of the form to get great surface complete of the item. The fibers which are in the form of woven mats are cut as per the mold size and placed at the surface of mold. Then the liquid form epoxy resin and the prescribed hardener (polymer) is mixed thoroughly in suitable proportion with a ratio of 10:1 and it is poured on to the mold surface where the fiber is placed. The polymer is uniformly spread with the help of roller. The second layer of the fiber is then put on the polymer surface and a roller is moved with a gentle weight on the fiber-polymer layer to evacuate any air caught and in addition the abundance polymer display. The procedure is rehashed for each layer

of polymer and fiber, till the required layers. In the wake of setting the plastic sheet, fluid paraffin is showered on the internal surface of the best form plate which is then kept on the stacked layers and the weight is connected. At that point the completed item is kept at room temperature or at some particular temperature, a form is opened and the created composite part is taken out and additionally handled. The season of curing relies upon sort of polymer utilized for composite handling. It is prompt an ordinary curing time of room temperature of 24-48 hours. This technique is essentially appropriate for thermosetting polymer- based composites. Capital and infrastructural prerequisite is less when contrasted with different strategies. Generation rate is less and high volume part of fortification is hard to accomplish in the prepared composites. Hand lay-up strategy discovers application in numerous territories like airship segments, car parts, vessel structures, dice board, deck and so forth.

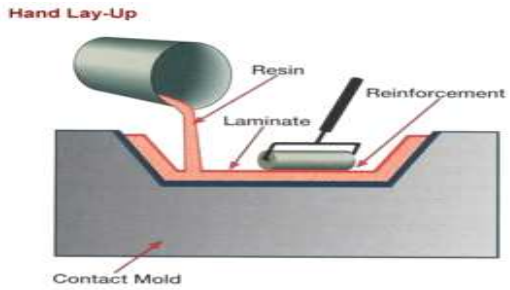

Figure 2: Typical Hand Lay – Up Technique

Wear Test

Wear is identified with associations amongst surfaces and particularly the expulsion and disfigurement of material on a surface because of mechanical activity of the contrary surface. By using a pin on disc tribometer the wear rate of the composite material is calculated under different parameters. A pin on disc apparatus (DUCOM, India) was used for investigating the dry sliding wear characterization of the fiber composites (as per ASTM G99 standard). The pin-on-disc apparatuses are an easy, cheap that can be used for the wear properties of the natural fiber. It can be done under the steady conditions without systematic variations it is used for model wear and lubricant behavior when the parts are having a linear relative velocity. The “pin” specimens, with dimensions of (8 x 25) mm, were tested against a disc counterface made of High chromium high carbon steel. Before each test, the disc counter face was prepared to carry out the test. First, the counter face was polished using sand paper. Then, it was cleaned using a wet piece of cloth with acetone, it is dried for 3 to 5 secs. The contact surfaces of the specimens were rubbed using sandpaper to achieve highly intimate contact between the specimens and the disc counter face. A dry soft brush was used to clean the specimen before and after testing, and a new specimen was prepared for each test. The roughness of the disc wear track, and the surfaces of the specimens were measured The weight of the specimen was obtained before and after testing using an electronic weight balance it is assigned as W1 and W2. The weight loss was then determined. The wear rate, friction force, coefficient of friction are calculated.

Input Parameters

Load-10NSliding velocity-1m/sec

Sliding distance-250m/sec

Sliding diameter-22mm

RPM-847

Time in sec-250

Time in min-4.008

Universal Testing Machine

A universal testing machine is also said to be as a universal tester in which it used to find the tensile strength, compressive strength and bending strength of the material. It consists of two main parts are the loading unit and the control panel. In the stacking unit comprises a vigorous base at the focal point of which is fitted to the principle chamber and cylinder. An inflexible casing comprising the lower table, the upper crosshead and the two straight segments is associated with this cylinder through a ball and attachment joint. A couple of screwed segments mounted on the base go through the fundamental nuts to help the lower cross-head. This cross head is climbed or down when the screwed segments are turned by an equipped engine fitted to the base. Each cross-head has a decreasing space at the inside into which are embedded a couple of racked jaws. These jaws are climbed or around the working handle on the cross-head confront and is planned to convey the plate (grasp) jaws for the ductile test example. A lengthening scale, which measures the relative development between the lower table and the lower cross-head, is likewise given the stacking unit. The control board contains the waterpowered power unit, the heap estimating unit and the control gadgets. The control gadget incorporates the electric control gadgets, the water is driven control gadgets and the heap demonstrating gadgets.

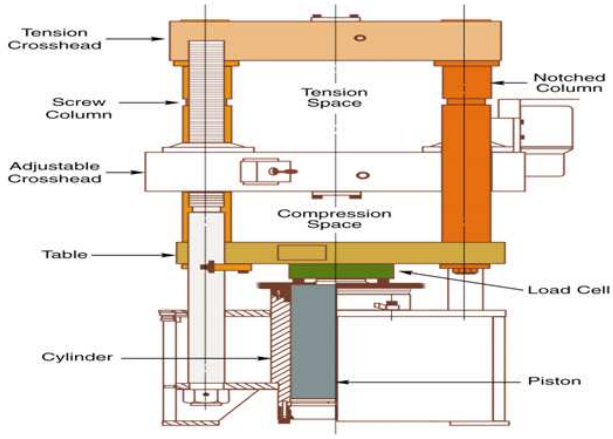

Figure 3

Tensile Test

Tensile test is a measurement of the force required to pull something. A structural beam to the point where it breaks the tensile strength of a material is the maximum amount of tensile stress that it can take before failure, for example breaking. It is performed for several reasons. The aftereffects of malleable tests are utilized as a part of choosing materials for building applications. Tractable properties much of the time are incorporated into material details to guarantee quality. Malleable properties regularly are estimated amid improvement of new materials and procedures, with the goal that distinctive materials and procedures can be looked at. At long last, pliable properties frequently are utilized to anticipate the conduct of a material under stacking. The quality of intrigue might be estimated regarding either the pressure important to cause calculable plastic twisting or the most extreme pressure that the material can withstand. These measures of quality are utilized, with an alert in building the outline. Additionally of intrigue is the material's malleability, which is a measure

of the amount it can be twisted before it breaks. the flexibility fused specifically in a plan; rather, it is utilized to guarantee quality and strength. Low malleability in a pliable test frequently is joined by low protection from break under different types of stacking. Flexible properties additionally might be of intrigue, however, uncommon strategies must be utilized to gauge these properties amid malleable testing. One material properties were broadly utilized and perceived is the quality of a material. We will complete a simple examination that gives loads of data about the quality or the mechanical conduct of a material, called the ductile test. The essential thought of a ductile test is to put an example of a material between two installations called "grasps" which cinch the material. The material has known measurements, similar to the length and cross-sectional zone. We at that point start to apply weight to the material grasped toward one side while the opposite end is settled. We continue expanding the weight (load or power) while in the meantime estimating the adjustment long of the example. Measure the adjustment long while including weight until the point when the part starts to extend lastly breaks. The consequence of this test is a diagram of load (measure of weight) versus removal (sum it extended). Since the measure of weight expected to extend the material relies upon the span of the material, a correlation between materials should be possible. After fabrication of leaf springs are experimentally tested on UTM machine at load intervals. The experimental data of deflection against load was recorded.

Table 1: Tensile Test Results

Test Parameters	Observed Values		
	ID-1	ID-2	ID-3
Gauge Thickness(Mm)	4.08	4.18	4.21
Gauge Width (Mm)	13.2	13.25	13.32
Original Cross Section Area (Mm^2)	53.856	55.385	56.077
Ultimate Tensile Load(Kn)	3.47	3.09	3.13
Ultimate Tensile strength (N/Mm^2 Or Mpa)	52.00	48.00	49.00

RESULTS AND DISCUSSIONS

To design composite leaf spring, Analysis is carried out in composite leaf spring of Hybrid composite materials. Analysis has been performed by using ANSYS Workbench by applying the boundary conditions and the load.

Deformation occurrence for 9 Layers

Table 2: Comparison of Composite Leaf Spring Deflections at Various Loads

Applied Load (Kg)	E-Glass Fiber	Aloevear Roselle Glass Fiber
1.50	4	3
2.100	13	14
3.150	21	25
4.200	30	38
5.250	39	58
6.300	51	65
7.350	61	100break

CONCLUSIONS

From the above analysis results while comparing the stress and deflection rate of 9 and 14 layer mono-leaf springs we come to a conclusion that the 14 layers mono-leaf spring have more strength than 9 layer mono leaf spring since it is a mono-leaf spring

REFERENCES

1. *Chegdani F, El Mansori M, Friction scale effect in drilling natural fiber composites, Tribology International(2018), doi: 10.1016/j.triboint.*
2. *Khan A, Jagdale P, Castellino M, Rovere M, Jehangir Q, Mandracci P,How to Rosso C, Tagliaferro A, Innovative functionalized carbon fibers from waste: enhance polymer composites properties, Composites Part B (2018), doi: 10.1016/j.compositesb.*
3. *Senthil Kumar, M.S., MohanaSundaraRaju, N., Sampath, P.S., Vivek, U., Tribological Analysis of Nano Clay/Epoxy/ Glass Fiber by using Taguchi's Technique, Materials and Design (2014),*
4. *Barari, Bamdad., Omrani, Emad., DorriMoghadam, Afsaneh.,Menezes, Pradeep L., Pillai, Krishna M., &Rohatgi, Pradeep K., Mechanical, Physical and Tribological Characterization of Nano-Cellulose Fibers Reinforced Bio-EpoxyComposites:An Attempt to Fabricate and Scale the 'Green' CompositeCarbohydratePolymerhttp://dx.doi.org/10.1016/j.carbpol.*
5. *Procedia Engineering 68 (2013) 431 – 438*
6. *Materials Today: Proceedings 4 (2017) 8633–8637.*
7. *Tribology International*
8. *Procedia Engineering 68 (2013) 130 – 137*
9. *L. Jiang, C. He, J. Fu, D. Chen, Wear behavior of straw fiber-reinforced polyvinyl chloride composites under simulated acid rain conditions, PolymerTesting(2017), doi:10.1016/j.polymertesting.*
10. *Physics Procedia 50 (2013) 453 – 460*
11. *Procedia Engineering 51 (2013) 561 – 566*
12. *Procedia Engineering 68 (2013) 145 – 151*
13. *Journal of Bionic Engineering 14 (2017) 141–150*
14. *B. Rashid, Z. Leman, M. Jawaid, M.J. Ghazali, M.R. Ishak and M.A. Abdelgnei, Dry Sliding Wear Behavior of Untreated and Treated SugarPalmFiber Filled Phenolic Composites using Factorial Technique, Wear,http://dx.doi.org/10.1016/j.wear.*
15. *Materials Today: Proceedings 2 (2015) 1381*
16. *Biotribology4(2005)18-29*
17. *Tribology international83(2015)77-104*
18. *Aruna, Chittineni, and R. Siva Ram Prasad. "Development of an Automated Framework to Resolve Software Testing Issues."*
19. *L. Jiang, C. He, J. Fu, D. Chen, Wear behavior of straw fiber-reinforced polyvinyl chloride composites under simulated acid rain conditions, Polymer How to Rosso C, Tagliaferro A, Innovative functionalized carbon fibers from waste: enhance polymer composites properties, Composites Part B (2018), doi: 10.1016/j.compositesb.*
20. *Senthil Kumar, M.S., MohanaSundaraRaju, N., Sampath, P.S., Vivek, U., Tribological Analysis of Nano*